

Titration Calculations Involving Endpoint

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021

Exercise

42. In a chemical analysis, only one quantitative reaction could be detected on the pH curve for the reaction of sodium sulfite with hydrochloric acid. In a subsequent titration, 10.00 mL of sodium sulfite solution was titrated with 0.225 mol/L hydrochloric acid. The average volume required at the endpoint for this titration was 14.2 mL. What is the concentration of the sodium sulfite solution?

43. Chemical analysis of a stain remover containing oxalic acid was conducted by a commercial analytical chemistry firm. Oxalic acid solution was titrated with 0.485 mol/L potassium hydroxide to the second endpoint, using phenolphthalein (Table 15.4). Calculate the concentration of the oxalic acid in this brand of stain remover.

44. A 25.0 mL sample of a cleaning solution, containing sodium hydrogen sulfide, was titrated with 0.500 mol/L sodium hydroxide using phenolphthalein indicator. At the endpoint, one drop of $\text{NaOH}_{(aq)}$ was sufficient to change the phenolphthalein indicator from colorless to pink. At this point, a stoichiometrically equivalent 10.2 mL of $\text{NaOH}_{(aq)}$ had been added. What is the concentration of sodium hydrogen sulfide in the cleaning agent?

45. A titration of phosphoric acid used in a commercial rust-removing solution with 0.125 mol/L sodium hydroxide was completed to the end of the second quantitative reaction. The equivalence point values are obtained from Figure 15.17. What is the concentration of the phosphoric acid solution?



46. In a chemical analysis, 10.00 mL samples of sodium sulfide solution used in an industrial process were titrated with 0.150 mol/L hydrochloric acid to the end of the second quantitative reaction. An average of 16.8 mL of $\text{HCl}_{(aq)}$ was required. What is the concentration of the sodium sulfide solution?

47. A titration of sulfuric acid with 0.484 mol/L sodium hydroxide was completed to the second endpoint. The evidence is displayed in Figure 15.28. Evidence from pH curves indicates that the reaction of sulfuric acid with the sodium hydroxide involves two quantitative reactions. Calculate the concentration of the sulfuric acid solution.

Table 15.4

TITRATION OF 25.0 mL OXALIC ACID WITH POTASSIUM HYDROXIDE

Ind	1	2	3
Final buret reading (mL)	17.1	32.7	48.3
Initial buret reading (mL)	1.4	17.1	32.7

Figure 15.28
Sodium hydroxide titrant is added to oxalic acid sample in successive trials.

Figure 15.17
Sodium hydroxide titrant is added to phosphoric acid sample in successive trials.

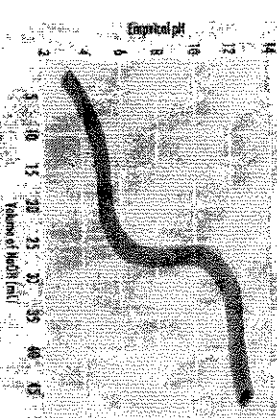
1 How is buffering action displayed on a pH curve?

2 How are quantitative reactions displayed on a pH curve?

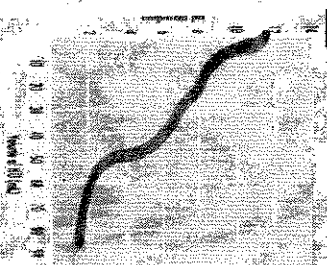
3 How is a pH curve used to choose an indicator for a titration?

4 An acetic acid sample is titrated with sodium hydroxide [Figure 15.25].

5 25.0 mL of 0.10 mol/L $\text{CH}_3\text{COOH}_{(aq)}$ titrated with 0.10 mol/L $\text{NaOH}_{(aq)}$



6 10.0 mL of 0.10 mol/L H_2SO_4 titrated with 0.10 mol/L $\text{NaOH}_{(aq)}$



5. a) Based on Figure above estimate the endpoint and the equivalence point.

b) Choose an appropriate indicator for this titration.

c) Write a Brønsted-Lowry equation for this reaction.

6. A sodium phosphate solution is titrated with hydrochloric acid [Figure above]

7. Why are only two endpoints shown in Figure above

a) Write three Brønsted-Lowry equations for the pH curve in Figure above

b) Communicate the position of each equilibrium.

c) Oxalic acid reacts quantitatively in a two-step reaction with a sodium hydroxide solution. Assuming that an excess of sodium hydroxide is added, sketch a pH curve (without any numbers) for all possible reactions.

Ans

42. 0.320 M

43. 0.152 M

44. 0.204 M

45. 73.5 mmol/L

46. 0.126 mol/L

47. 0.278 mol/L

Name: